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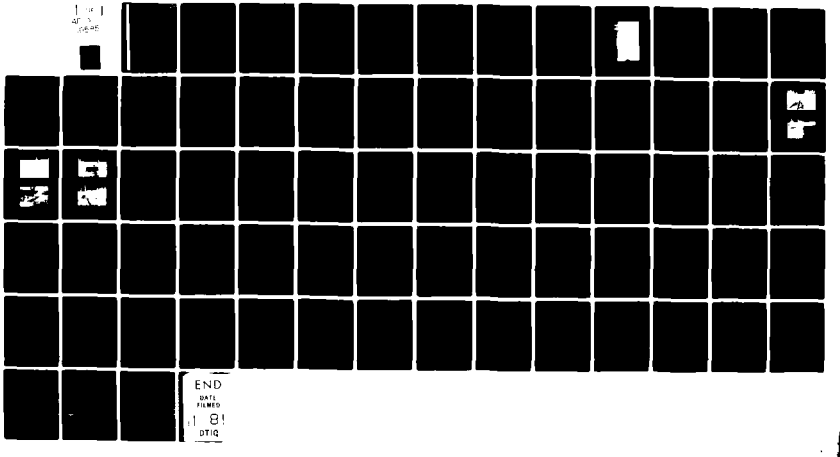

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PASSAIC RIVER BASIN
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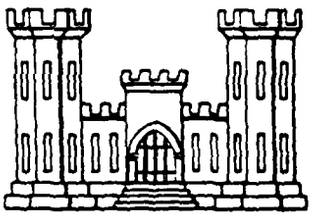
TUXEDO LAKE DAM

LEVEL II

ORANGE COUNTY, NEW YORK
INVENTORY NO. N.Y. 14

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



NEW YORK DISTRICT CORPS OF ENGINEERS

AUGUST 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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4. TITLE (and Subtitle) Phase I Inspection Report Tuxedo Lake Dam Passaic River Basin, Orange County, N.Y. Inventory No. 14	5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) GRANVILLE LESTER, JR.	8. CONTRACT OR GRANT NUMBER(s) DACW51-81-C-0010
9. PERFORMING ORGANIZATION NAME AND ADDRESS Michael Baker, Jr. Inc. 4301 Dutch Ridge Road Box 280 Beaver, PA 15009	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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National Dam Safety Program. Tuxedo Lake Dam (Inventory Number NY 14), Passaic River Basin, Lower Hudson River Area, Orange County, New York. Phase I Inspection Report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability

Tuxedo Lake Dam
Orange County
Passaic River Basin

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report provides information and analysis on the physical condition of the dam at the report time. Information and analysis are based on visual observation of the dam by the performing organization.

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal any conditions which constitute an immediate hazard to human life or property.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Using the Corps of Engineers screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 32 percent of the Probable Maximum Flood (PMF). Therefore, the spillway is adjudged as "seriously inadequate", and the dam is assessed as "unsafe, non-emergency."

The "unsafe" classification applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. However, it does mean that, based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity, so that if a severe storm were to occur, overtopping and failure of the dam are likely to take place, significantly increasing the hazard to loss of life downstream.

It is therefore recommended that, within 3 months of notification of the owner, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam. The results of this investigation and analyses will determine the appropriate remedial measures which be required. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance must be provided during these periods.

Current inspection and maintenance procedures by the owner are adequate, but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TUXEDO LAKE DAM
I.D. No. NY 14
DEC DAM No. 196A-354, LOWER HUDSON RIVER BASIN
ORANGE COUNTY, NEW YORK

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Tuxedo Lake Dam (I.D. No. NY 14)
State:	New York
County:	Orange
Stream:	Summit Brook
Date of Inspection:	9 March 1981

ASSESSMENT

Examination of available documents and a visual inspection of the dam and appurtenant structures did not reveal any conditions which constitute an immediate hazard to human life or property.

Using the Corps of Engineers screening criteria, it has been determined that the dam would be overtopped for all storms exceeding approximately 32 percent of the Probable Maximum Flood (PMF). Therefore, the spillway is adjudged as "seriously inadequate", and the dam is assessed as "unsafe, non-emergency."

The "unsafe" classification applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. However, it does mean that, based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity, so that if a severe storm were to occur, overtopping and failure of the dam are likely to take place, significantly increasing the hazard to loss of life downstream.

It is therefore recommended that, within 3 months of notification of the owner, detailed hydrologic and hydraulic investigations of the structure should be undertaken to more accurately determine the site-specific characteristics of the watershed and their effects upon the overtopping potential of the dam. The results of this investigation and analyses will determine the appropriate remedial measures which be required. In the interim, a detailed emergency action plan must be developed and implemented during periods of unusually heavy precipitation. Also, around-the-clock surveillance must be provided during these periods.

Current inspection and maintenance procedures by the owner are adequate, but need to be documented. Monitoring of the reservoir levels should be expanded to include readings during peak flow periods.

The following remedial measures must be completed within one year:

1. The erosion near the left training wall on the upstream slope must be filled and protected from future erosion.

2. The outlet works must be made operable.

3. All low areas and depressions on the crest must be filled, compacted, and seeded.

4. All trees and brush on the upstream slope and on the downstream slope near the spillway must be cut off at ground level. All trees with a trunk diameter greater than 3 inches must have their root systems removed. All resultant areas of erosion and cavaties must be filled, graded, compacted, and seeded.

5. Install a staff gage to monitor pool levels.

SUBMITTED: _____
Granville Kester, Jr., P.E.
Vice President
MICHAEL BAKER, JR., of New York, INC.

APPROVED: _____
Colonel W.M. Smith, Jr.
New York District Engineer

DATE: 14 Aug 81

Overall View of Dam
Tuxedo Lake Dam
I.D. No. NY 14
9 March 1981

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TUXEDO LAKE DAM
I.D. No. NY 14
DEC DAM No. 196A-354
LOWER HUDSON RIVER BASIN
ORANGE COUNTY, NEW YORK

SECTION 1: PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Phase I Inspection reported herein was authorized by the Department of the Army, New York District, Corps of Engineers, to fulfill the requirements of the National Dam Inspection Act, Public Law 92-367.

b. Purpose of Inspection - This inspection was conducted to evaluate the existing conditions of the dam, to identify deficiencies and hazardous conditions, to determine if these deficiencies constitute hazards to life and property, and to recommend remedial measures where required.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam - Tuxedo Lake Dam is an earthfill embankment 638 feet long and 12.5 feet high from the toe of the spillway to the minimum top of dam. The embankment has a crest width of 45 feet. The upstream and downstream faces of the embankment have slopes of 1V:2H (Vertical to Horizontal). The upstream face is protected by riprap up to normal pool and is lined with trees and brush.

The spillway is located 130 feet from the right abutment. The spillway consists of two 9.25 foot wide channels, 45 feet long which are separated by a 5-foot thick masonry and earth wall. A concrete bridge extends over both of these channels with an opening of 2.5 feet between the low chord of the bridge and the bottom of the channel. The entrance to the right channel is controlled by a 12-inch wide concrete, broad-crested weir with a crest elevation about 1 foot above the bottom of the channel. The entrance to the left channel is controlled by a 12-inch high wooden stop log that can be raised by means of a screw and wheel mechanism located off the edge of the bridge. With this stop log raised, the reservoir can be lowered 1 foot.

The water passes over the spillway and falls 9.5 feet into an oval rocklined stilling basin that discharges to another stilling basin. Flow out of the stilling basin enters a 6-foot diameter conduit that runs underground for over 500 feet to discharge into a rectangular concrete channel before entering a lower lake. This lower lake then discharges into We-Wah Lake.

b. Location - Tuxedo Lake Dam, on Summit Brook, is 1 mile west of Tuxedo Park, New York. The reservoir and dam are in Orange County, New York. The coordinates of the dam are N 41° 12.4' and W 74° 12.2'. Tuxedo Lake Dam can be found on the Sloatsburg, New York, USGS 7.5 minute topographic quadrangle.

c. Size Classification - Tuxedo Lake Dam has a height of 12.5 feet and a reservoir storage capacity at the minimum top of dam of 3431 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - Immediately downstream of Tuxedo Lake Dam are tennis courts, a clubhouse, a parking lot, and a swimming pool. Just below the parking lot near the outlet conduit is one home. The possibility of excessive economic damage and loss of life in the event of a failure places Tuxedo Lake Dam in the "high" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership - The dam is owned and operated by the Village of Tuxedo Park, We-Wah Road, Tuxedo Park, New York, 10987. The contact person is Mr. Richard Morrow (telephone 914-351-4743).

f. Purpose of the Dam - The dam and reservoir are used for water supply and recreation.

g. Design and Construction History - Tuxedo Lake Dam was built in 1898 for the Tuxedo Park Association for water supply and recreation. Some work was done on the dam in the 1930's, but no information is available on that work.

h. Normal Operating Procedures - Tuxedo Lake is normally kept at the spillway crest for use as water supply for the Village and lake residents.

1.3 PERTINENT DATA

a. Drainage Area (Square Miles) - 3.06

b. Discharge at Dam (c.f.s.) -

Spillway Capacity (at Minimum Top of Dam Elev. 560.0 ft. M.S.L.)	297.0

c. Elevations (Feet Above M.S.L.)[1] -

Minimum Top of Dam	560.0
Normal Pool (Spillway Crest)	557.0
Streambed at Toe of Dam	547.5

d. Reservoir Surface (Acres) -

Top of Dam (Elev. 560.0 ft. M.S.L.)	307.0
Spillway Crest (Elev. 557.0 ft. M.S.L.)	277.0

e. Reservoir Storage Capacity (Acre-Feet) -

Top of Dam (Elev. 560.0 ft. M.S.L.)	3431.0
Spillway Crest (Elev. 557.0 ft. M.S.L.)	2556.0

f. Dam -

Type: Earth	
Length (Feet)	638.0
Height (Feet)	12.5
Top Width (Feet)	45.0
Side Slopes - Upstream	1V:2H
Downstream	1V:2H

g. Spillway -

Type: Two 2.6 x 9.25 openings under bridge.	
Crest Length Perpendicular to Flow (Feet)	18.5
Crest Width Parallel to Flow (Feet)	45.0
Crest Elevation (ft. M.S.L.)	557.0

h. Reservoir Drain - Outlet is inoperable and has been abandoned.

[1]All elevations are referenced to the spillway crest, Elev. 557.0 ft. M.S.L., estimated from the USGS 7.5 minute topographic quadrangle, Sloatsburg, NY.

SECTION 2: ENGINEERING DATA

2.1 GEOLOGY

Tuxedo Lake Dam is located in the southern end of the "New England Uplands" physiographic province of New York State. This province is geologically complex and characteristically composed of diverse metamorphic and igneous rock. Bedrock occurring in the immediate vicinity of the dam, as indicated on the Geologic Map of New York (J.G. Broughton and others, 1970), is represented by Precambrian, gray to green quartz-plagioclase gneiss.

The dam lies on the immediate west side of a northeast-southwest trending reverse or thrust fault plane. The fault plane extends along the downstream reservoirs to the northeast across the Hudson River and ends near Honness Mountain. Repeated glaciation has occurred over the entire area during the Pleistocene Epoch. The most recent advance ended approximately 11,000 years ago.

2.2 SUBSURFACE INVESTIGATIONS

Original subsurface information was not available for reference as a part of this investigation. According to the available soils report (preliminary) for Orange County, prepared by the Soil Conservation Service, the majority of local surface materials consist of "Hollis Rocky Association" and "Hollis Rock Outcrop Association". These soils are described as shallow, excessively drained, moderately coarse textured soils. The depth to bedrock is one to two feet and has a low permiability.

2.3 DAM AND APPURTENANT STRUCTURES

No design or construction plans for Tuxedo Lake Dam were available for this investigation. The dam was built in 1898 and some repairs were made in the 1930's, although no records of these repairs were available for this investigation.

The dam is assumed to consist of a homogeneous earth embankment, due to lack of information concerning the materials. The spillway consists of two 9.25-foot wide channels. One of the openings contains a wooded stop log that can be removed to lower the lake surface one foot. The spillway has a vertical stepped outfall and masonry training walls. The spillway discharges into a rock-lined, oval stilling basin.

2.4 CONSTRUCTION RECORDS

No construction records were available for this investigation.

2.5 OPERATING RECORDS

The water level in the reservoir is normally kept at the spillway crest. No records of maintenance or inspections are kept. Maintenance is performed as needed.

2.6 EVALUATION OF DATA

Background information collected during this investigation was obtained from Mr. Richard Morrow of the Village of Tuxedo Park. Available engineering data are considered adequate and reliable for Phase I Inspection purposes.

SECTION 3: VISUAL INSPECTION

3.1 FINDINGS

a. General - The inspection was performed on 9 March 1981. The weather was partly cloudy with a temperature of 40° F. The water surface was 0.33 feet above the spillway crest. Deficiencies found during the inspection will require remedial measures. A Field Sketch of conditions found during the inspection is included in Appendix E. The complete Visual Inspection Checklist is presented as Appendix B.

b. Spillway - The spillway is located 130 feet from the right abutment and consists of two 2.6 x 9.25 openings with a bridge above it. The spillways have a length of 45 feet (parallel to the flow) with a stepped vertical outfall. The training walls are of masonry construction. The crest of the left spillway channel can be lowered 1 foot by raising a stop log.

The bottom of the spillway is made of rock slabs. Minor erosion was observed at the left training wall. Minor wetness on both sides of spillway training walls was observed, indicating areas of minor seepage. No significant flows or signs of turbidity were noted.

c. Embankment - The dam has a crest width of 45 feet. A low area was noted about 75 feet from the right abutment. A 3 feet by 15 feet by 0.5 feet depression was observed near what might be an underground utility line. A nine foot diameter depression was observed about 575 feet from the right abutment. Several utility lines pass through the dam and the manholes are located on the dam crest.

Minor erosion was noted near the left training wall on the upstream slope. Trees and brush were located along the upstream slope.

Brush and trees were located at the bottom and along the downstream slope near the spillway. Tennis courts were located immediately beyond the downstream toe. Forty-five feet downstream of the toe is an excavated pit, 3.5 feet wide by 5 feet long by 2 feet deep.

d. Outlet Works - The outlet works were abandoned and could not be located in the field.

e. Downstream Channel - The spillway discharges into a rock lined, oval stilling basin 80 feet long and 35 feet wide. This basin discharges into another basin that discharges into a 6-foot diameter concrete pipe that runs to a lower lake. The lower lake discharges into We-Wah Lake.

A clubhouse, tennis courts, parking lot, and swimming pool are located immediately downstream of the dam. A home is located near the outlet of the 6-foot conduit below the parking lot.

f. Reservoir - The reservoir slopes are steep and forested with scattered dwellings. Sedimentation was not reported to be a problem. There were no signs of slope instability.

3.2 EVALUATION

The visual inspection revealed several deficiencies in this structure. The following items were noted:

1. Minor wetness was observed on both sides of the spillway training walls.

2. Minor erosion was noted near the left training wall on the upstream slope.

3. The outlet works are no longer operable.

4. A low area was observed on the crest about 75 feet from the right abutment.

5. A 3-foot by 15-foot and 0.5-foot deep depression was observed near what might be an underground utilty.

6. A 9-foot diameter depression is located approximately 50 feet from the left abutment.

7. Trees and brush are growing along the upstream slope of the embankment.

8. Brush and trees are located on the downstream slope of the embankment near the spillway.

SECTION 4: OPERATION AND MAINTENANCE PROCEDURES

4.1 PROCEDURES

There are no formal written instructions for operating the reservoir. The dam is checked frequently because the reservoir is used for water supply. No records are kept on inspections of the dam. The reservoir is normally kept at the crest of the spillway.

4.2 MAINTENANCE OF THE DAM

Maintenance of the dam is the responsibility of the Village of Tuxedo Park. Maintenance of the dam is considered fair. The grass is mowed and kept in good condition. Maintenance is performed as needed. It is recommended that formal records of examinations be recorded for future reference.

4.3 WARNING SYSTEM

There was no warning system or emergency action plan in operation at the time of inspection.

4.4 EVALUATION

Past maintenance of the dam and operating facilities appears to have been adequate, but the past activities have gone undocumented except for the water level measurements. A checklist should be compiled by the owner's representative to document the findings made during the periodic inspections and the maintenance items completed. A warning system and emergency action plan should be developed and put into operation.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 DRAINAGE AREA CHARACTERISTICS

Delineation of the Tuxedo Lake Dam watershed was made using the USGS quadrangle for Sloatsburg, New York. The drainage basin consists of moderate to steep slopes which are well covered by forests and ground vegetation with some residential development. No significant storage exists upstream of the reservoir. The total drainage area of the dam is 3.06 square miles.

5.2 ANALYSIS CRITERIA

A hydrologic analysis of the watershed and hydraulic analysis of the dam was conducted using the U.S. Army Corps of Engineers' Flood Hydrograph Package HEC-1 DB computer program (Reference 12, Appendix D). The unit hydrograph was defined using the Snyder's Unit Hydrograph Method. Estimates of Snyder's hydrograph coefficients were developed from average coefficients from the Hydrologic Flood Routing Model for Lower Hudson River Basin (Reference 15, Appendix D). Precipitation data was taken from Hydrometeorological Report No. 33 (Reference 8, Appendix D). Rainfall losses were estimated at an initial loss of 1.0 inch and a constant loss rate of 0.1 inch per hour thereafter. The hydraulic capacity of the dam, reservoir, and spillway was determined by incorporating the Modified Puls Routing Method. All flood routings were begun with the reservoir at normal pool level. Outlet discharge capacity was computed by hand. The Probable Maximum Flood (PMF) and 1/2 Probable Maximum Flood (1/2 PMF) were developed and routed through the reservoir.

5.3 SPILLWAY CAPACITY

The spillway capacity at the top of the dam is 297 cubic feet per second (c.f.s.). There is no auxiliary or emergency spillway at Tuxedo Lake Dam.

5.4 RESERVOIR CAPACITY

The storage capacity of Tuxedo Lake Dam at normal pool is 2556 acre-feet. The storage capacity of the reservoir at the minimum top of dam is 3431 acre-feet. Therefore, flood control storage of the reservoir between the spillway crest and top of dam is 875 acre-feet. This volume represents a total of 5.36 inches of runoff from the watershed.

5.5 FLOODS OF RECORD

No information concerning the effects of significant floods on the dam is available.

5.6 OVERTOPPING POTENTIAL

The maximum capacity of the spillway is 297 c.f.s. before overtopping would occur. The outflow from the PMF and 1/2 PMF is 5490 c.f.s. and 1471 c.f.s., respectively. This capacity results in the ability of the spillway to pass 32 percent of the PMF before the dam would be overtopped.

5.7 RESERVOIR EMPTYING POTENTIAL

The reservoir can be drawn down 1 foot by raising the wooden stop log in the left spillway channel. The outlet works for the dam have been abandoned and are no longer operable.

5.8 EVALUATION

Tuxedo Lake Dam is an "intermediate" size - "high" hazard dam requiring the spillway to pass a flood in the range of the PMF. The PMF and 1/2 PMF were routed through the watershed and dam. It was determined that the spillway is capable of passing 32 percent of the PMF before overtopping the dam. Therefore, the spillway is judged to be "seriously inadequate."

Conclusions pertain to present conditions, and the effect of future development on the hydrology has not been considered.

SECTION 6: STRUCTURAL STABILITY

6.1 EVALUATION OF EMBANKMENT STABILITY

a. Visual Observations - No signs of instability were observed during the visual inspection. Minor problems noted that are related to the stability of the structure include:

1. Low spots observed on the crest of the dam.

2. Minor wetness was observed on both downstream training walls of the spillway.

3. Erosion was noted at the left training wall.

b. Design and Construction Data - Design and construction information related to the stability of the structure was not available.

c. Operating Records - The water level in the reservoir is normally kept at the spillway crest. No operating records are kept.

d. Post Construction Changes - It was reported by the owner's representative that work to repair the dam was performed in 1930 but no information on these repairs was available for this investigation.

6.2 STABILITY ANALYSIS

The results of a previous stability analysis, if any, were not available for review during this investigation.

The dam is assumed to be a generally homogeneous embankment composed of well-graded ML soils. The dam is 12.5 feet high with a crest width of 45 feet. The upstream and downstream slopes are 1V:2H. The outlet works for the dam are no longer operable.

Because of the small height of the dam, history of satisfactory performance of the slopes, and because no signs of instability were noted during this investigation, Therefore, no further stability analysis is deemed necessary.

6.3 SEISMIC STABILITY

Tuxedo Lake Dam is located in Seismic Zone 1, which presents no earthquake hazards, according to the Recommended Guidelines for Safety Inspection of Dams

by the Department of the Army, Office of the Chief of Engineers. This determination is contingent on the requirements that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7: ASSESSMENT/RECOMMENDATIONS

7.1 ASSESSMENT

a. Safety - The Phase I Inspection of Tuxedo Lake Dam revealed that the spillway is "seriously inadequate", based on the Corps of Engineers screening criteria: outflows from any storm in excess of 32 percent of the PMF will overtop the dam. For this reason, the dam has been assessed as "unsafe, non-emergency".

The "unsafe" classification applied to a dam because of a "seriously inadequate spillway" is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. However, it does mean that, based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that a severe storm would cause overtopping and failure of the dam, significantly increasing the hazard to loss of life downstream from the dam.

b. Adequacy of Information - The information available and the observations and measurements made during the visual inspections are considered sufficient for this Phase I Inspection Report.

c. Need for Additional Investigation - Detailed hydrologic and hydraulic investigations of the watershed and reservoir area are considered necessary to more accurately determine the overtopping potential of the dam and to determine appropriate mitigating measures in response to the spillway inadequacy.

d. Urgency - The detailed hydrologic and hydraulic investigations must be initiated within three months of owner notification. With one year, remedial measures resulting from these investigations must be initiated, with their completion during the following year. In the interim, a detailed emergency action plant must be developed and implemented during periods of unusually heavy precipitation. Around-the-clock surveillance must also be provided during these periods. The problem areas listed herein must be corrected within one year of notification.

7.2 RECOMMENDED MEASURES

The regular inspections and maintenance procedures presently being conducted by the owner's representative appear to be adequate, although some form of the documentation is needed. A thorough checklist should be compiled by the owner's representative and completed during each inspection. Maintenance items should be completed annually. Monitoring of the reservoir levels should be expanded to include reservoir levels above normal pool.

The wet areas near the masonry spillway training walls should be monitored regularly and during periods of high reservoir levels for any signs of increased flow and turbidity. If increased flow or turbidity is noted, a qualified geotechnical engineering firm is to be retained to perform a stability check of the dam and develop remedial measures to reduce the flow.

The following remedial measures must be completed within one year of notification:

1. The erosion near the left training wall on the upstream slope must be filled and protected from future erosion.

2. The outlet must be made operable.

3. All low areas and depressions on the crest must be filled, compacted, and seeded.

4. All trees and brush on the upstream slope and downstream slope near the spillway must be cut off at ground level. All trees with a trunk diameter greater than 3 inches should have their root systems removed. All resultant areas of erosion and cavities should be filled, graded, compacted, and seeded.

5. Install a staff gage to monitor pool levels.

APPENDIX A

PHOTOGRAPHS

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Note: Photographs were taken on 9 March 1981.

Photo 1. View of Crest of Dam From Left Abutment
9 March 1981

Photo 2. View of Upstream Slope From Left Abutment
9 March 1981

Photo 3. View of Downstream Slope From Left Abutment
9 March 1981

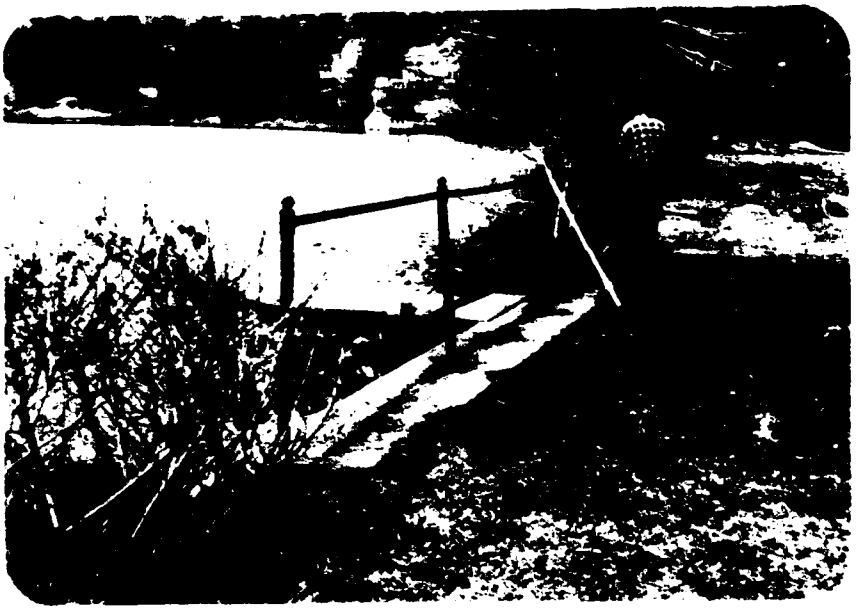


Photo 4. View of Spillway Entrance
9 March 1981

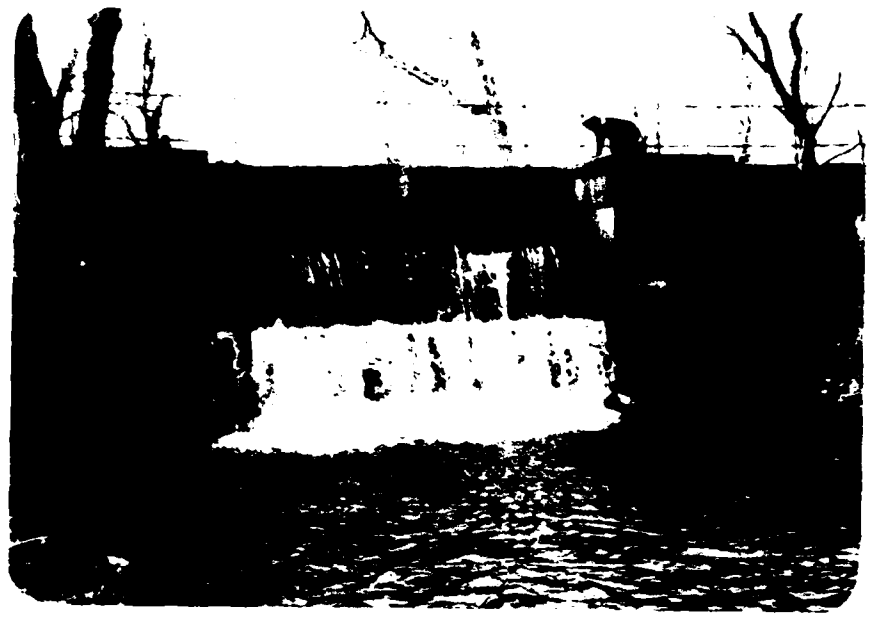


Photo 5. View of Spillway Discharge
9 March 1981

Photo 6. View of Excavated Pit to the Left and Downstream of the Spillway Structure
9 March 1981

APPENDIX B

VISUAL INSPECTION CHECKLIST

VISUAL INSPECTION CHECKLIST

1) Basic Data

a. General

Name of Dam Tuxedo Lake Dam

Fed. I.D. # NY 14 DEC Dam No. 196A - 354

River Basin Passaic River - Lower Hudson Area

Location: Town Tuxedo Park County Orange

Stream Name Summit Brook

Tributary of Ramapo River

Latitude (N) 41° 12.4' Longitude (W) 72° 12.2'

Type of Dam Earth

Hazard Category High

Date(s) of Inspection 9 March 1981

Weather Conditions Partly cloudy, 40°F.

Reservoir Level at Time of Inspection 557.33 ft.

b. Inspection Personnel James G. Ulinski, Anthony P. Klimek,
Steven M. Lockington

c. Persons Contacted (Including Address & Phone No.) 914-351-4743
Richard Morrow
Village of Tuxedo Park
We-Wah Road
Tuxedo Park, NY 10987

d. History:

Date Constructed 1889 Date(s) Reconstructed 1930

Designer Unknown

Constructed By Unknown

Owner Tuxedo Park Association

2) Embankment

a. Characteristics

(1) Embankment Material Well-graded ML soils.

(2) Cutoff Type No information available

(3) Impervious Core No information available

(4) Internal Drainage System None observed

(5) Miscellaneous

b. Crest

(1) Vertical Alignment No problems observed

(2) Horizontal Alignment No problems observed

(3) Surface Cracks None observed

(4) Miscellaneous Crest width of the dam is 45 ft. Low area at station 0+75 A 3 x 15 x 0.5 (W x L x D) parallel to what may be an underground utility. A 9 ft. diameter depression at Station 5+75.

c. Upstream Slope

(1) Slope (Estimate) (V:H) 1V:2H

(2) Undesirable Growth or Debris, Animal Burrows Trees and brush along upstream slope.

(3) Sloughing, Subsidence, or Depressions Minor erosion observed at left training wall.

(4) Slope Protection Riprap present on the upstream slope.

(5) Surface Cracks or Movement at Toe None observed

d. Downstream Slope

(1) Slope (Estimate - V:H) 1V:2H

(2) Undesirable Growth or Debris, Animal Burrows Brush observed near spillway.

(3) Sloughing, Subsidence or Depressions None observed

(4) Surface Cracks or Movement at Toe None observed

(5) Seepage Minor wetness on both sides of spillway near the masonry walls indicating areas of seepage. No significant flows or signs of turbidity were noted.

(6) External Drainage System (Ditches, Trenches, Blanket)

(7) Condition Around Outlet Structure Outlet structure is no longer operable.

(8) Seepage Beyond Toe None observed

e. Abutments - Embankment Contact No problem observed

(1) Erosion at Contact None

(2) Seepage Along Contact None

3) Drainage System

a. Description of System None observed

b. Condition of System

c. Discharge from Drainage System

4) Instrumentation (Monumentation/Surveys, Observation Wells, Weirs, Piezometers, Etc.) None

5) Reservoir

a. Slopes Slopes around the reservoir are steep.

b. Sedimentation Sedimentation was not reported to be a problem.

c. Unusual Conditions Which Affect Dam None observed

6) Area Downstream of Dam

a. Downstream Hazard (No. of Homes, Highways, etc.) One home downstream; tennis courts, clubhouse, and swimming pool at downstream toe.

b. Seepage, Unusual Growth 40 ft. downstream of dam is an excavated pit, 3.5 ft. wide by 5 ft. long by 2 ft. deep. Trees and brush near spillway.

c. Evidence of Movement Beyond Toe of Dam None observed

d. Condition of Downstream Channel The downstream channel is a 6-ft. diameter conduit that appeared to be in good condition.

7) Spillway(s) (Including Discharge Conveyance Channel)

The spillway is located about 130 ft. from right abutment.

a. General The spillway consists of a weir type control with two 2.5 x 9.25 ft. openings. There is a bridge over the spillway.

b. Condition of Service Spillway The service spillway is made of rock slabs with masonry training walls. The outfall is a vertical, stepped face. The spillway was in fair condition.

c. Condition of Auxiliary Spillway None

d. Condition of Discharge Conveyance Channel The spillway falls into a stilling basin that outflows to another basin which discharges into a 6-ft. diameter conduit which discharges into a lower lake. The conduit was in good condition.

8) Reservoir Drain/Outlet - Inoperable

Type: Pipe _____ Conduit _____ Other _____

Material: Concrete _____ Metal _____ Other _____

Size: _____ Length _____

_____ _____

Invert Elevations: Entrance _____

Exit _____

Physical Condition (Describe): Unobservable _____

Material: _____

Joints: _____ Alignment _____

Structural Integrity: _____

_____

_____

Hydraulic Capability: _____

_____

Means of Control: Gate _____ Valve _____ Uncontrolled _____

Operation: Operable _____ Inoperable _____ Other _____

Present Condition (Describe): _____

_____

_____

_____

_____

9) Structural - Not Applicable

a. Concrete Surfaces _____

_____

_____

_____

b. Structural Cracking _____

_____

_____

c. Movement - Horizontal & Vertical Alignment (Settlement) _____

_____

_____

d. Junctions with Abutments or Embankments _____

_____

_____

e. Drains - Foundation, Joint, Face _____

f. Water Passages, Conduits, Sluices _____

g. Seepage or Leakage _____

h. Joints - Construction, etc. _____

i. Foundation _____

j. Abutments _____

k. Control Gates _____

l. Approach & Outlet Channels _____

_____

_____

_____

m. Energy Dissipators (Plunge Pool, etc.) _____

_____

_____

n. Intake Structures _____

_____

_____

_____

o. Stability _____

_____

p. Miscellaneous _____

_____

_____

10) Appurtenant Structures (Power House, Lock, Gatehouse, Other)

a. Description and Condition None

_____

_____

_____

_____

APPENDIX C

HYDROLOGIC/HYDRAULIC DATA AND COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject TUXEDO LAKE DAM S.O. No.
APPENDIX C Sheet No. of
Drawing No.
Computed by JML Checked by Date

TABLE OF CONTENTS

CHECK LIST FOR DAMS
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

AREA-CAPACITY DATA:

		Elevation (ft.)	Surface Area (acres)	Storage Capacity (acre-ft.)
1)	Top of Dam	560.0	307	3,431
2)	Design High Water (Max. Design Pool)	--	--	--
3)	Auxiliary Spillway Crest	--	--	--
4)	Pool Level with Flashboards	--	--	--
5)	Service Spillway Crest	557.0	277	2,556

DISCHARGES

		Volume (cfs)
1)	Average Daily	Unknown
2)	Spillway @ Maximum High Water - Top of Dam -	297
3)	Spillway @ Design High Water	Unknown
4)	Spillway @ Auxiliary Spillway Crest Elevation	N/A
5)	Low Level Outlet	N/A
6)	Total (of all facilities) @ Maximum High Water	297
7)	Maximum Known Flood	Unknown
8)	At Time of Inspection	11

CREST: ELEVATION: 560.0 ft.

Type: Earthfill embankment

Width: 45 ft. Length: 638 ft.

Spillover Broad-crested weir

Location 130 ft. from right abutment

SPILLWAY:

SERVICE		AUXILIARY
557.0 ft.	Elevation	None
Broad-crested weir	Type	--
18.50 total	Width	--
	Type of Control	
X	Uncontrolled	--
	Controlled:	
--	Type (Flashboards; gate)	--
--	Number	--
--	Size/Length	--
	Invert Material	--
	Anticipated Length of Operating Service	--
--	Chute Length	--
--	Height Between Spillway Crest & Approach Channel Invert (Weir Flow)	--

HYDROMETEROLOGICAL GAGES:

Type: None

Location: _____

Records:

Date: _____

Max. Reading: _____

FLOOD WATER CONTROL SYSTEM:

Warning System: None

_____

Method of Controlled Releases (mechanisms):

_____

_____

_____

DRAINAGE AREA: 3.06 sq. mi.

DRAINAGE BASIN RUNOFF CHARACTERISTICS:

Land Use - Type: Forests

Terrain - Relief: Steep

Surface - Soil: Well-drained

Runoff Potential (existing or planned extensive alterations to existing surface or subsurface conditions)

No known plans to change existing conditions.

Potential Sedimentation problem areas (natural or man-made; present or future)

No sedimentation problems reported.

Potential Backwater problem areas for levels at maximum storage capacity including surcharge storage:

No problems observed.

Dikes - Floodwalls (overflow & non-overflow) - Low reaches along the Reservoir perimeter:

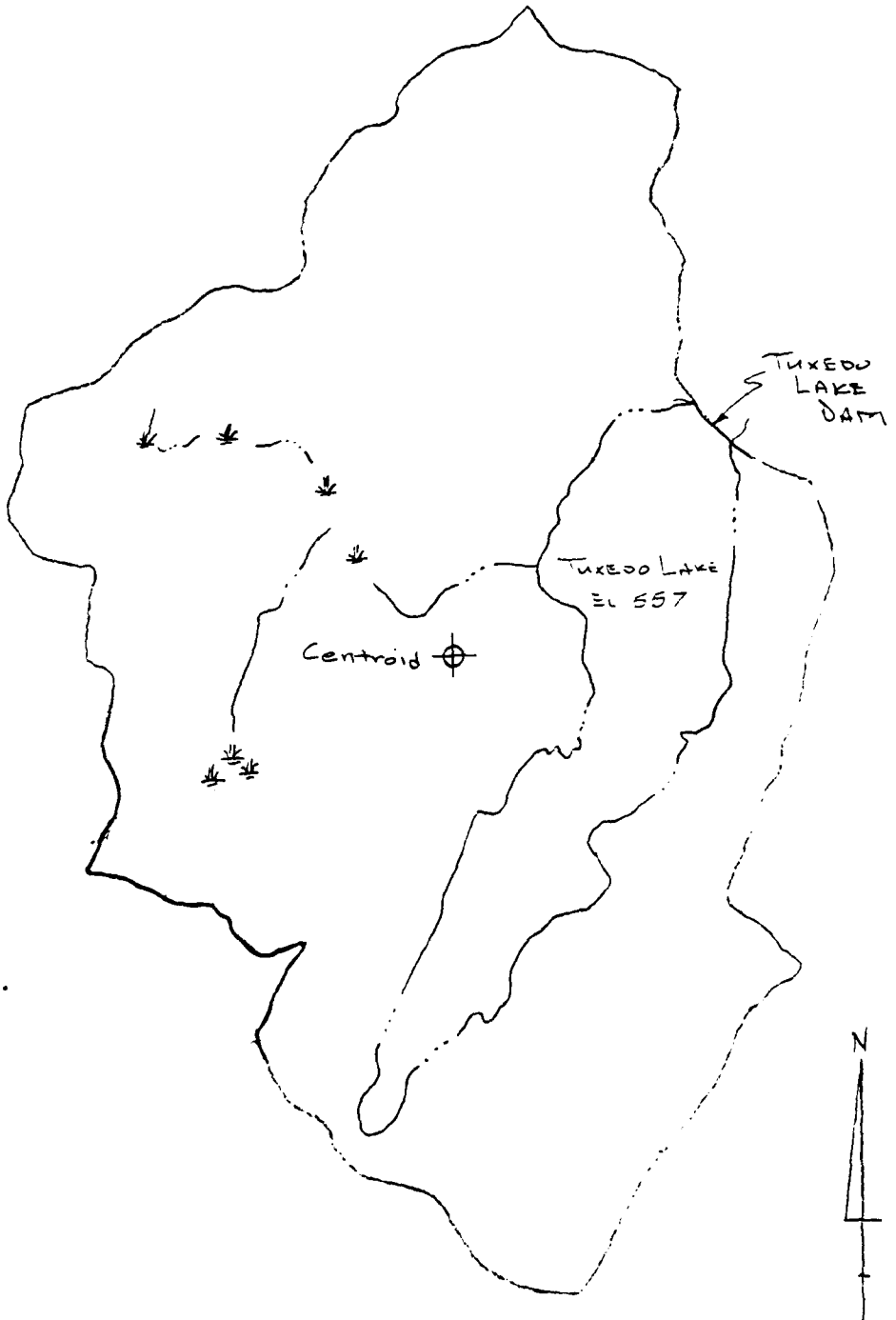
Location: None

Elevation:

Reservoir:

Length @ Maximum Pool 9,300 ft. (1.76 mi.)

Length of Shoreline (@ Spillway Crest) 23,300 ft. (441 mi.)



TUXEDO LAKE DAM
DRAINAGE AREA MAP

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject N.Y. Dam Insp. S.O. No. 13889-00-AAA-0
Tuxedo Lake Dam Sheet No. 6 of 18
Drawing No.
Computed by [illegible] Checked by WLS Date 1/12/81

DRAINAGE AREA = 1,961 Ac = 3.06 mi²

SURFACE AREAS:

LAKE @ ELEV 557 – 276.9 Ac = 0.43 mi²
" 560 – 306.7 Ac = 0.48 mi²
" 580 – 351.7 Ac. = 0.55 mi²

Watershed Lengths

L = 10,820 ft. = 2.05 mi
Lc = 4,100 ft. = 0.78 mi

$T_p = C_p (L \times L_{CA})^{.3}$ $C_p = 0.63$
$= 2.0 (2.05 \times .78)^{.3}$ $C_T = 2.00$
$T_p = 2.30$

ADJUSTMENT FOR INTERVAL
$T_R = 2.30/5.5 = 0.42$ HR USE 0.5 HR.
$T_{IR} = T_I + \frac{T_R - T_a}{4} = 2.30 + \frac{.42 - .5}{4} = 2.28$

PRECIPITATION DATA

HMR-33 ZONE 1

PMP 24 hr – 200 mi² = 21.9 inches
D.A. Less than 10 mi²

Duration	% of 200 mi²	inches
6 hr PMP	111	24.3
12 hr PMP	123	26.9
24 hr PMP	133	29.1
48 hr PMP	142	31.1

TP-40

100 YR-24 hr Rainfall = 7.5 inches
" 12 hr " 6.4 "
" 6 hr " 5.3 "

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Box 280
Beaver, Pa. 15009

Subject TUTTLE LAKE DAM S.O. No.

Sheet No. 7 of 18

Drawing No.

Computed by SMA Checked by [illegible] Date 3/13/81

SURFACE AREA RESERVOIR BOTTOM

SURFACE AREA EL. 557 276.9 ACRES

EQUIVALENT CIRCLE RADIUS = 1959.43 FT.

AVERAGE SIDE SLOPE S=5.87 4:V

DEPTH D = 9.52 BOTTOM OF SPILLWAY

RADIUS BOTTOM RESERVOIR

$1959.43 - (5.87)(9.52) = 1903.55$

SURFACE AREA BOTTOM RESERVOIR 261.3 ACRES

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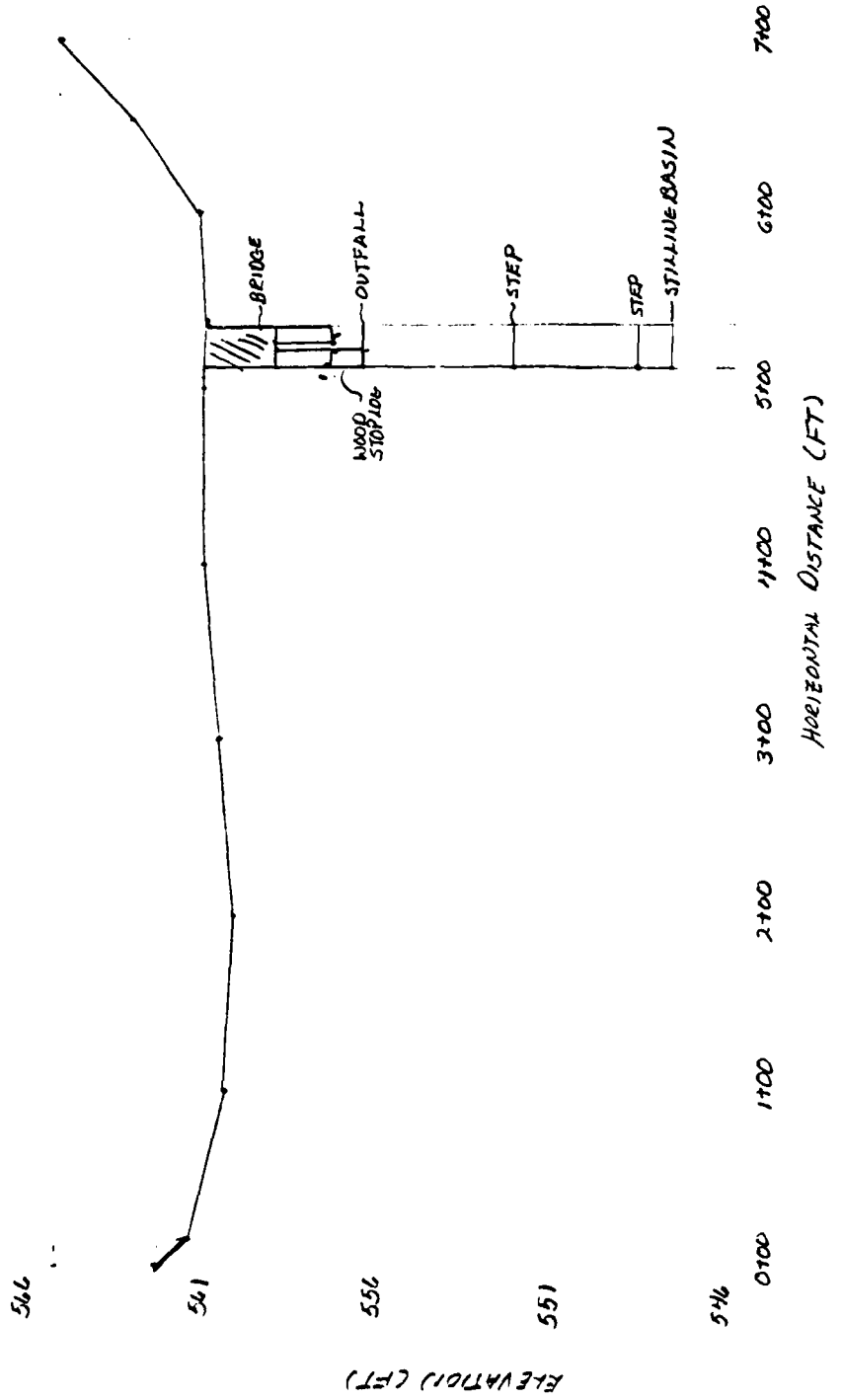
Beaver, Pa. 15009

Subject TUXEDO LAKE DAM S.O. No.
TOP OF DAM PROFILE Sheet No. 8 of 10
Drawing No.
Computed by SML Checked by [illegible] Date 3/12/91



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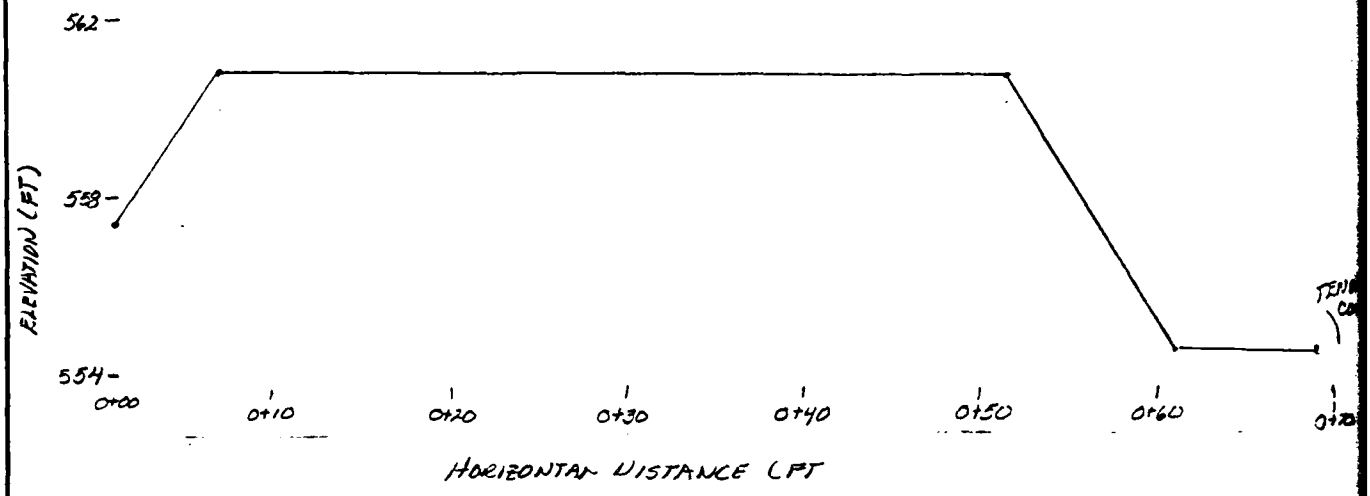
Subject TUXEDO LAKE DAM S.O. No.
TYPICAL CROSS SECTION (STA 4+00) Sheet No. 9 of 18
Drawing No.
Computed by SML Checked by JE Date 3/12/91



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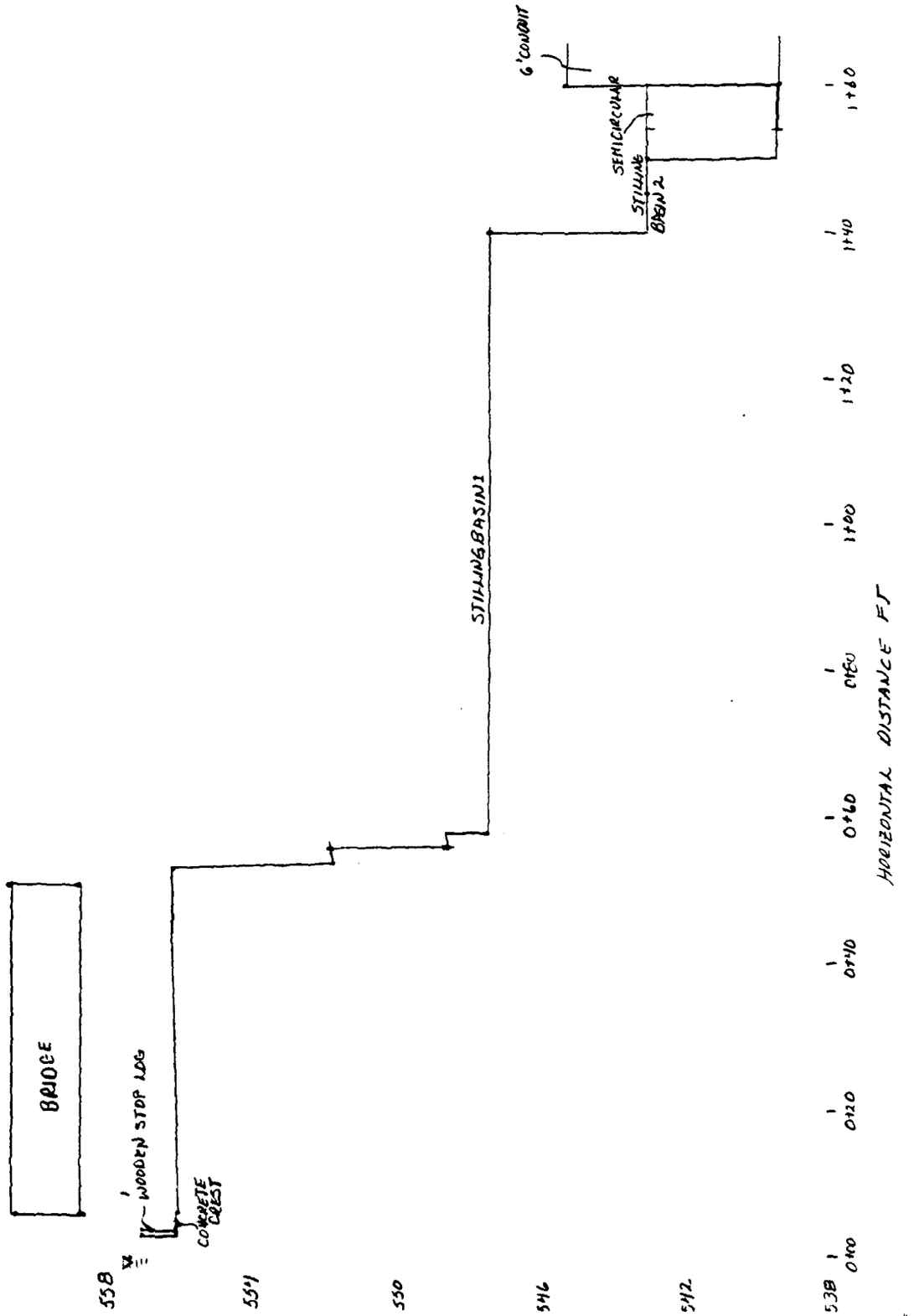
Box 280
Beaver, Pa. 15009

Subject TUXEDO LAKE DAM S.O. No.
SPILLWAY CROSS SECTION (STA 5+12) Sheet No. 10 of 18
Drawing No.
Computed by SML Checked by Date 3/12/81



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Box 280
Beaver, Pa. 15009

Subject TUXEDO LAKE DAM S.O. No.
RATING CURVES Sheet No. 11 of 18
Drawing No.
Computed by SML Checked by [illegible] Date 3/12/81

THE RATING CURVES WERE COMPUTED BY ASSUMING THE FLOW PASSES THROUGH CRITICAL DEPTH OVER THE STOP LOG. THE EQUATIONS ARE AS FOLLOWS

$$y_c = H/1.5$$

WHERE H IS THE DEPTH OF WATER OVER THE STOP LOGS

$$Q = A\sqrt{g y_c}.$$

AS THE WATER LEVEL APPROACHES THE BOTTOM OF THE BRIDGE THERE IS A POSSIBILITY OF ORIFICE FLOW. THE EQUATION FOR ORIFICE FLOW IS AS FOLLOWS

$$Q = CA\sqrt{2gH}$$

AND $C = 0.61$ (BRATER + KING).

USING THE ABOVE TWO EQUATIONS THE LOWER FLOW WILL CONTROL. AS THE FLOW TOPS THE DAM THE FLOW WILL PASS THROUGH CRITICAL DEPTH ON THE DOWNSTREAM EDGE AND $Q = A\sqrt{gD}$ WILL BE USED. THE OPENINGS ARE 2.61 x 9.25 AND THERE ARE TWO OPENINGS

SPILLWAY							
	WEIR			ORIFICE			
ELEV (FT)	y_c (FT)	AREA (FT^2)	Q (CFS)	AREA (FT^2)	H (FT)	Q (CFS)	CONTROLLING FLOW
557	0	—	—	0	—	—	—
558	0.67	12.33	57.1	NA	—	—	WEIR
559	1.3	24.7	161.6	48.3	1.7	308.3	WEIR
560	2.0	37.0	296.9	"	2.7	388.5	WEIR
561.3	2.9	53.0	509.32	"	4.0	472.9	ORIFICE
562.8				"	5.5	554.5	"
564.3				"	7.0	625.66	"
568.6					11.3	794.8	"

ORIFICE H = ELEV - 557.3
ORIFICE CONTROLS ABOVE 560

MICHAEL BAKER, JR., INC.
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Box 280
Beaver, Pa. 15009

Subject: TUXEDO LAKE DAM
SPILLWAY RATING CURVES
S.O. No. ______
Sheet No. 12 of 18
Drawing No. ______
Computed by: JMA Checked by: [signature] Date: 3/13/81

OVERTOPPINE AND COMBINED FLOW

ELEVATION AT SPILLWAY (FT)	AREA (FT^2)	TOPWIDTH (T, FT)	HYDRAULIC DEPTH (A/T, FT)	VELOCITY $V=\sqrt{gD}$ (FT/SEC)	FLOW Q=AV (CFS)	HEAD LOSS $H=V^2/2g$ (FT)	RESERVOIR ELEVATION (FT)	SPILLWAY FLOW (CFS)	COMB FLOW (CFS)
561	347.90	618	0.56	4.26	1481.2	0.28	561.3	472.9	1954.1
562	484.5	630	1.56	7.09	6983.63	0.78	562.8	554.5	7538.1
563	1703.46	668	2.55	9.06	15436.1	1.27	564.3	625.56	16061.7
566	3835.53	731.[illegible]	5.25	13.00	49854.8	2.62	568.6[illegible]	794.8	50649.6

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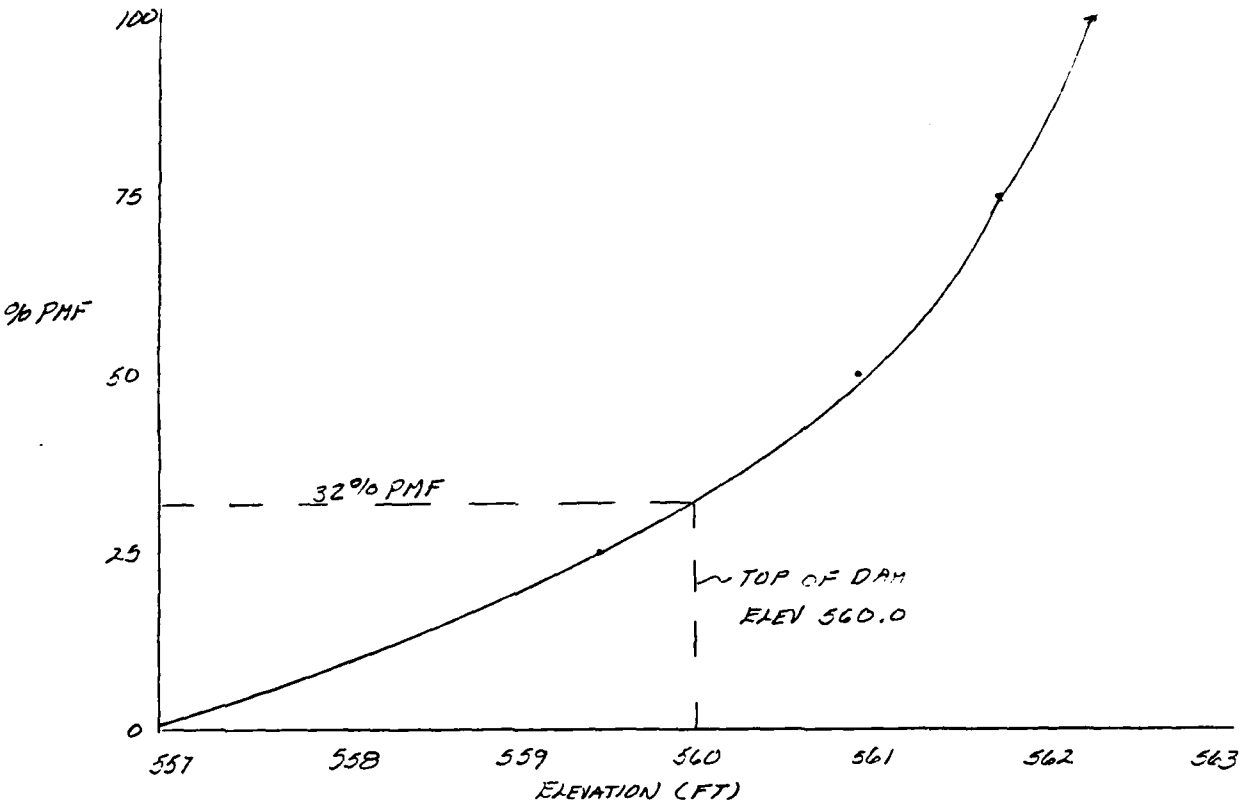
Box 280
Beaver, Pa. 15009

Subject TUXEDO LAKE DAM — S.O. No.
CAPACITY ANALYSIS — Sheet No. 13 of 18
Drawing No.
Computed by SML — Checked by — Date 3/19/81



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*************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  26 FEB 79
  RUN DATE:           04 JUN 79
*************************************
A1      NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
A2      HYDROLOGIC AND HYDRAULIC ANALYSIS OF TUXEDO LAKE DAM
A3      UNIT HYDROGRAPH BY SNYDERS METHOD
B     300       0      30       0       0       0       0       0      -4       0
B1      5
J       1       9       1
J1    1.0    0.75     0.5    0.25
K       0       1                                               1
K1      RUNOFF HYDROGRAPH TO DAM
M       1       1    3.05
P            21.0     111     123     133     142
T                                                             1.0    0.10
W    2.33    0.63
X    -1.5   -0.05     2.0
K       1       2                                               1
K1      ROUTING FOR TUXEDO LAKE DAM
Y                                       1       1
Y1      1                                                    -557      -1
Y4    557     558     559     560   561.5   562.8   564.5
Y5      0    57.1   161.0   296.9  1954.1  7538.1 16051.7
$A  261.5   270.7   306.7   351.7
$E  547.5    557.    560.    580.
$$    557
$D    553
K      99
```

SHEET 14 OF 18

THIS PAGE ...
FROM COPY ...

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
[illegible] UPDATE [illegible]
****

RUN DATE 03/16/81
TIME 08.13

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF [illegible] LAKE DAM
UNIT HYDROGRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
600	0	30	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 0.75 0.50 0.25

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF HYDROGRAPH TO DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.30	0.0	3.06	0.0	0.0	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	21.73	111.00	123.00	133.00	142.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.10	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 2.30 CP=0.55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 26 END-OF-PERIOD ORDINATES, LAG= 2.31 HOURS, CP= 0.55 VOL= 1.00

48.	175.	337.	470.	[illegible]	[illegible]	390.	314.	247.	195.
153.	120.	95.	75.	59.	47.	37.	[illegible]	[illegible]	[illegible]
14.	11.	9.	7.	5.	4.				

HYDROGRAPH ROUTING

ROUTING FOR TOXAWAY LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR
0.0	0.0	0.0	1	1	0	0		0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-557.	-1

STAGE	557.00	558.50	559.00	560.00	561.50	562.00	564.50
FLOW	0.0	37.10	121.00	296.50	1954.10	7538.10	16031.70

SURFACE AREA=	261.	277.	307.	352.
CAPACITY=	0.	2550.	3431.	10310.
ELEVATION=	548.	557.	560.	580.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
557.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
563.0	0.0	0.0	0.

PEAK OUTFLOW IS 3690. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 3532. AT TIME 44.00 HOURS

PEAK OUTFLOW IS 1471. AT TIME 45.00 HOURS

PEAK OUTFLOW IS 224. AT TIME 47.50 HOURS

SHEET 16 OF 18

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	557.00	577.00	580.00
STORAGE	2556.	2955.	3431.
OUTFLOW	0.	0.	297.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	582.25	2.25	4127.	5430.	12.50	43.50	0.0
0.75	581.72	1.72	3953.	3552.	10.00	44.00	0.0
0.50	580.92	0.92	3714.	1971.	11.00	45.00	0.0
0.25	577.46	0.0	2657.	2.4.	0.0	47.50	0.0

SHEET 18 OF 18

APPENDIX D

REFERENCES

REFERENCES

1. University of the State of New York, Geology of New York, Education Leaflet 20, 1966.

2. Broughton, John G. and others, "Geologic Map of New York - Lower Hudson Sheet," New York State Museum and Science Service, Map and Chart Series No. 15, 1970.

3. Dunbar, Carl O. and Waage, Karl M., Historical Geology, John Wiley and Sons, Inc., New York, 1969.

4. Soil Conservation Service, Soil Interpretations for Orange County, Orange County, New York, U.S. Department of Agriculture, January 1972.

5. Bureau of Reclamation, U.S. Dept. of the Interior, Design of Small Dams, A Water Resources Technical Publication, 1977.

6. Chow, Ven Te, Handbook of Applied Hydrology, McGraw - Hill Book Company, New York, 1964.

7. Chow, Ven Te, Open Channel Hydraulics, McGraw - Hill Book Company, New York, First Edition, 1959.

8. HMR 33, "Seasonal Variations of Probable Maximum Precipitation, East of the 105th Meridian for Areas 10 to 1000 Square Miles and Durations of 6 to 48 Hours," (1956).

9. King, Horace Williams and Brater, Ernest F., Handbook of Hydraulics, Fifth Edition, McGraw - Hill Book Company, New York, 1963.

10. Soil Conservation Service, "National Engineering Handbook - Section 4, Hydrology," U.S. Department of Agriculture, 1964.

11. Soil Conservation Service, "National Engineering Handbook - Section 5, Hydraulics," U.S. Department of Agriculture.

12. U.S. Army, Hydrological Engineering Center, "Flood Hydrograph Package (HEC-1), Dam Safety Investigations, Users Manual," Corps of Engineers, Davis, California, September 1978.

13. U.S. Army, "Inventory of United States Dams," Corps of Engineers, 9 September 1978.

14. U.S. Army, Office of the Chief of Engineers, "Appendix D, Recommended Guidelines for Safety Inspection of Dams," National Program of Inspection of Dams, Volume 1, Corps of Engineers, Washington, D.C., May 1975.

15. George, Thomas S. and Taylor, Robert S., Hydrologic Flood Routing Model For Lower Hudson River Basin, Water Resources Engineers, Inc., 8001 Forbes Place, Suite 312, Springfield, Virginia, January 1977.

16. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-163 (Draft Engineering Manual), "Spillway and Freeboard Requirements for Dams, Appendix C, Hydrometeorological Criteria and Hyetograph Estimates," (August 1975).

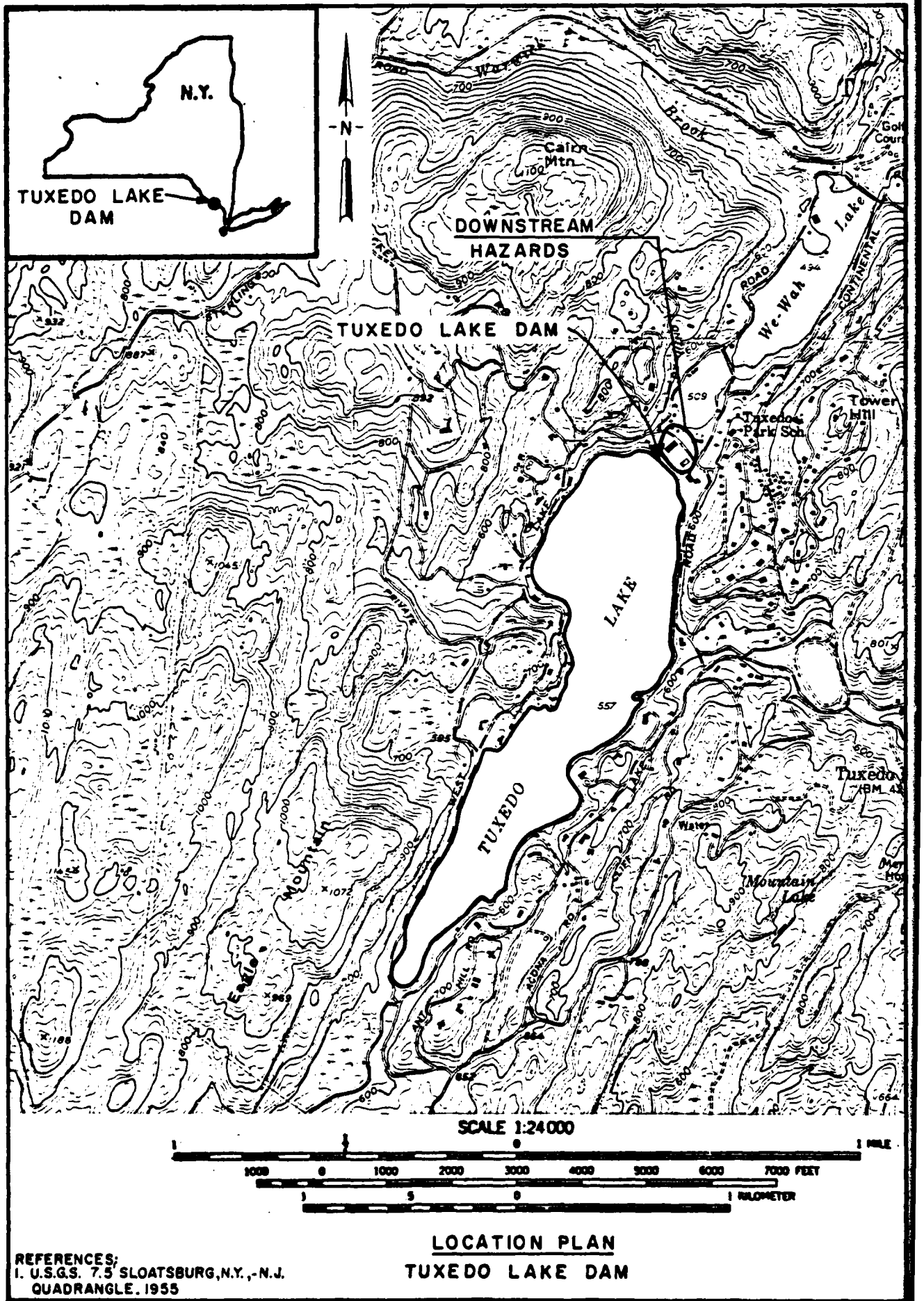
17. U.S. Army, Office of the Chief of Engineers, Engineering Circular EC-1110-2-188, "Engineering and Design, National Program of Inspection of Non-Federal Dams," Corps of Engineers, Washington, D.C., 30 December 1977.

18. U.S. Army, Office of the Chief of Engineers, Engineer Technical Letter No. ETL 1110-2-234, "Engineering and Design, National Program of Inspection of Non-Federal Dams, Review of Spillway Adequacy," Corps of Engineers, Washington, D.C., 10 May 1978.

APPENDIX E

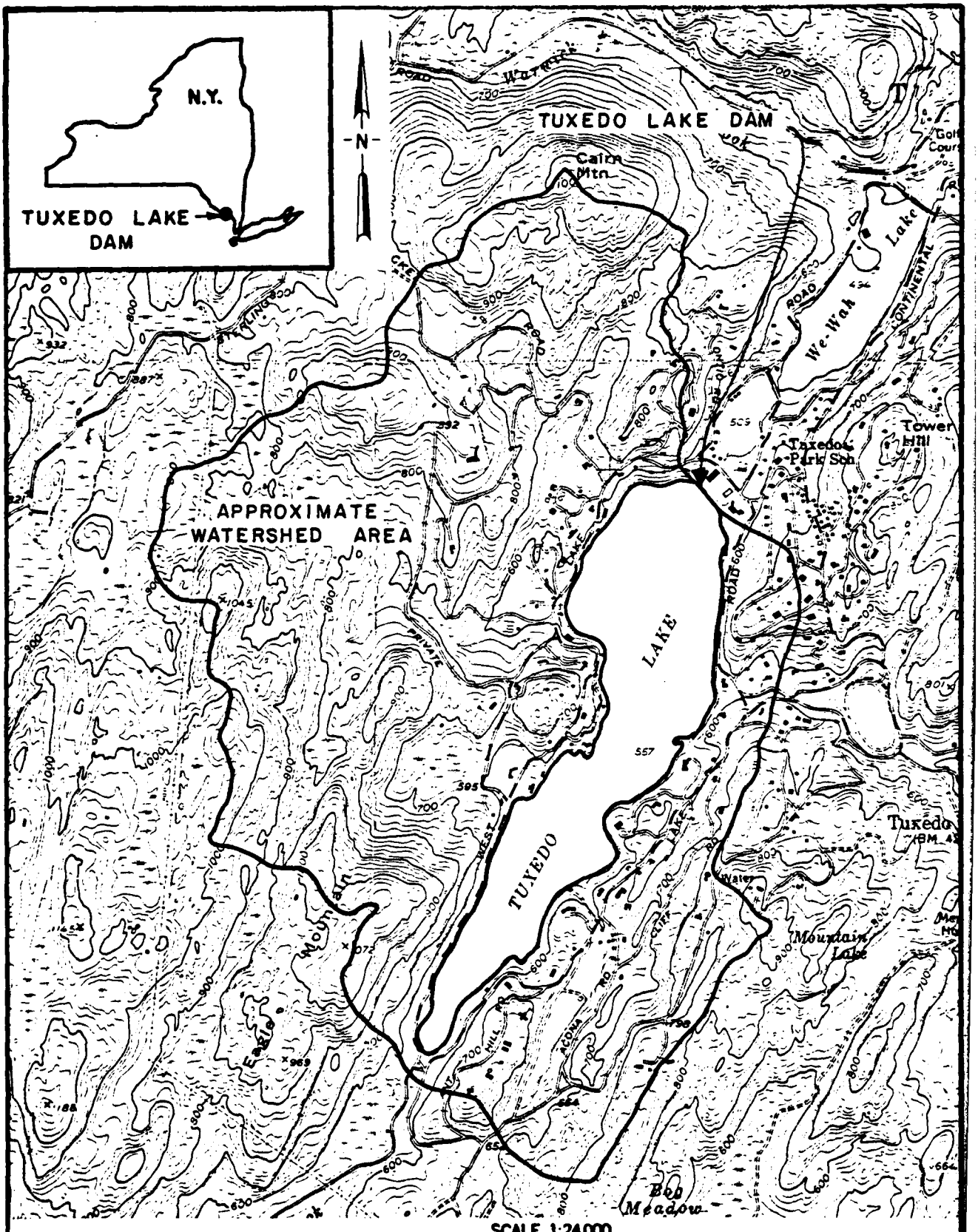
DRAWINGS

CONTENTS



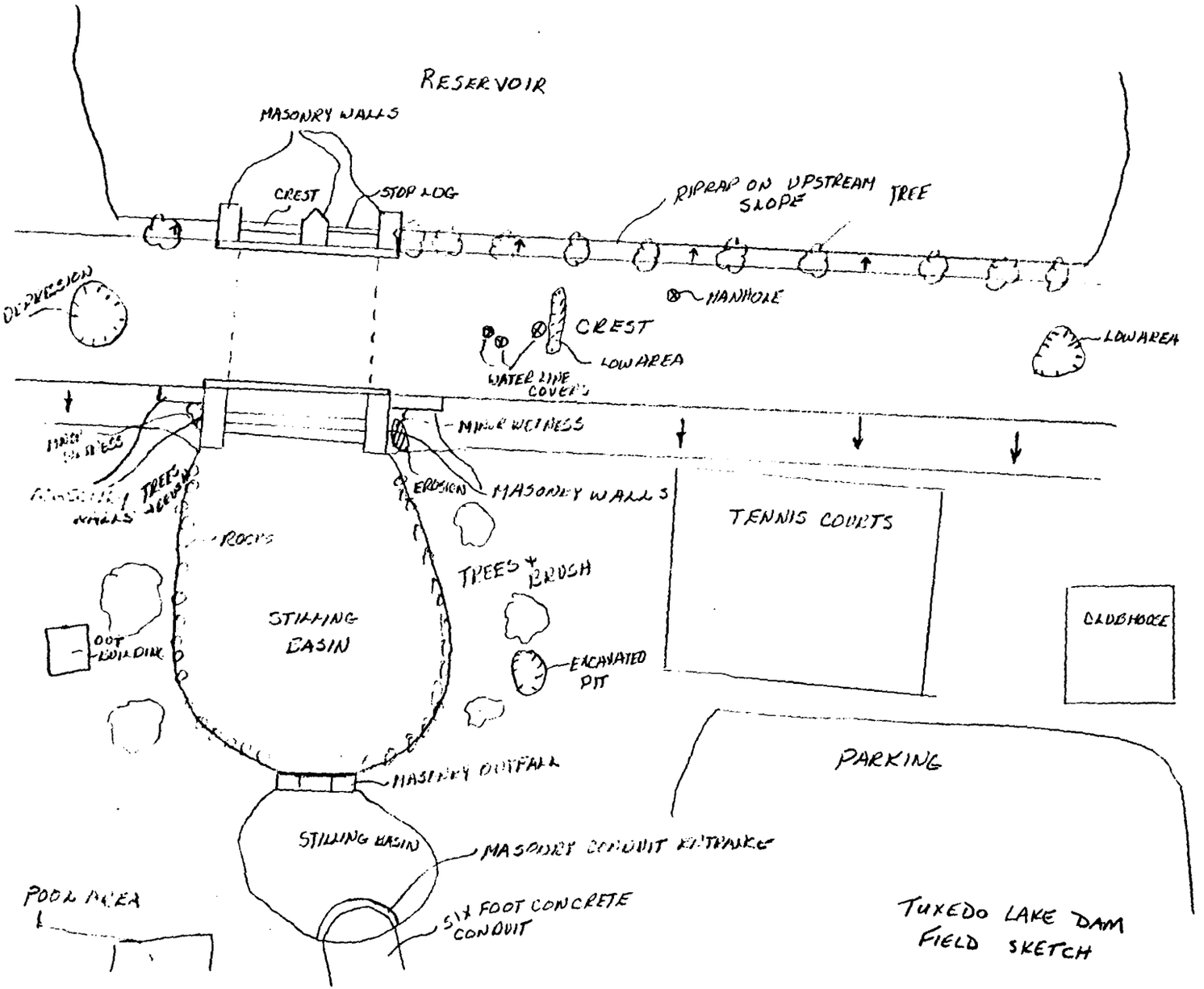
LOCATION PLAN
TUXEDO LAKE DAM

REFERENCES;
1. U.S.G.S. 7.5 SLOATSBURG, N.Y., - N.J. QUADRANGLE. 1955



REFERENCES:
1. U.S.G.S. 7.5' SLOATSBURG, N.Y.-N.J. QUADRANGLE. 1955

WATERSHED MAP
TUXEDO LAKE DAM



APPENDIX F

BACKGROUND DOCUMENTS

35 4 2 11

January 4, 1912.

In re Dams 346 and 358 Lower Hudson.

George Griswold, Esq.,

Tuxedo Park Association,

Tuxedo Park, N. Y.

Dear Sir:-

In re Tuxedo Lake outlets which I examined on December 30th with Mr. Patterson, I find in looking at the geological maps that there is more of a drainage area on the west shore of the lake than I had thought, and suggest on the south end instead of putting in another culvert on the road, that the culvert now there in place be placed along the culvert in the road below at the same end of the lake and alongside of the one now in place and that the road on the south end be spanned with the bridge with masonry piers, so as to get a width of about 18 feet and at least three feet wide. Connecting these two piers on the lake side a wall should be built at least two feet wide by three feet deep; the top of this wall to be about six inches higher than the proposed spillway at the north end. The object of this wall between the piers is to prevent any washout in this sluiceway.

In re outlet at the north end of the lake. At the next low water of the lake I suggest that the spillway be built at this point instead of the present gates over which the water can flow to have the lake rise above the desired point. If possible the top of this spillway should be five feet below the top of the

roadway, but in any case it should be at least four foot below.

With these two outlets on the north and south, I think you will be provided for any emergency without any danger to your roadway.

Should be very glad to see the plans when you have decided upon them.

Very truly yours,

Inspector of Dams and Docks.

McK/C.

534 LH

November 9, 1911.

Tuxedo Park Association,

Tuxedo Park, N. Y.

Gentlemen:-

I find that the outlet to your lake consists of two openings 8 feet wide and 6 feet deep in which the overflow is impeded through wooden gates, and consider that there is a possibility, if the water in the lake was high and a very heavy rainfall, for the same overflowing your earthen embankment, washing same away and damaging your winter and tennis clubs and perhaps the lives of any who may be there at the time.

I consider that a waste weir should be built, depending upon the height you wish the water kept at, and until such a waste is built the openings for 5 feet below the roadway should be absolutely clear of everything which might impede the overflow of the water, including gates, wire screens, etc.

Very truly yours,

Inspector of Dams and Docks.

McK/C.

35-84 L 14

Tuxedo Park.

Owned by the Tuxedo Park Association.

This is an earthen embankment with two openings each 8 feet wide by 6 feet deep. There is no spillway. I suggest that until a spillway is built to a depth of 5 feet below the road embankment that the openings be absolutely free from gates or anything which would impede the overflow of the water and all screens be removed to this height.

Inspected November 4, 1911.